National Aeronautics and Space Administration

2014
CAPACITY BUILDING

NASA Earth Science
Applied Sciences Program

www.nasa.gov

Capacity Building: 2014 Annual Summary

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I. Introduction

The ESD Applied Sciences Program promotes efforts to discover and demonstrate innovative and practical uses of Earth observations. The Program funds applied science research and applications projects to enable near-term uses of Earth observations, formulate new applications, integrate Earth observations and related products in practitioners' decision making, and transfer the applications. The projects are carried out in partnership with public- and private-sector organizations to achieve sustained use and sustained benefits from the Earth observations.

The Applied Sciences Capacity Building program (CBP) builds capacity within the United States and the developing world to 1) expand the Earth observations user base, and 2) increase the awareness within non-traditional audiences of NASA Earth observations data and products. The Capacity Building program builds capacity across the nine Societal Benefit Areas of the interagency U.S. Group on Earth Observations.[1]

The Capacity Building program works through both program and element activities. Program activities include participating in international capacity building, e.g., the Group on Earth Observations (GEO) and the Committee on Earth Observation Satellites (CEOS), and identifying partnership opportunities to reach new end users. Program element activities include Applied Remote Sensing Training (ARSET), which provides training to access and utilize Earth observations data, tools, and services; DEVELOP, which focuses on workforce development and building end user engagement through 10-week applied research project opportunities; the Gulf of Mexico Initiative (GOMI), which focuses on region-specific coastal challenges through partnerships with state and local agencies; and the Regional Visualization and Monitoring System (SERVIR), which is a collaboration with the U.S. Agency for International Development (USAID) that builds capacity to use geospatial information in national decision making through partnerships with intergovernmental institutions in regions around the world.

II. 2014 Overview

In 2014, Capacity Building continued to strengthen the program and increase productivity through strategic planning and new management initiatives. A 2013 peer-review assessment and its major findings were synthesized into a 2014 findings report, which set the foundation for the formulation of results frameworks—an outcome-based approach to identify objectives as well as interim and longer-term results. Draft indicators for tracking progress within each element, and the program as a whole, were identified. The program began developing a five-year strategic plan that will be formalized in 2015, following the completion of the overall Applied Sciences Program's strategy for the next five years.

CBP continued to track geographic reach as one of the indicators for the Program. Projects in specific geographic areas, end users from specific states/nations who participated in projects or training courses, and DEVELOP participant locations were

[1] The nine USGEO SBAs are Agriculture, Climate, Disasters, Ecological Forecasting, Energy, Health, Oceans, Water Resources, and Weather.

aggregated to show where we work. As shown in the U.S. and international maps below, CBP worked in 47 states and 107 countries, a decrease of three states and an increase of 24 countries compared with 2013. Targets for the number of states and countries we plan to reach will be piloted in 2015, based on the past two years of tracking geographic reach. In addition, CBP participated in U.S. interagency and international Earth observations capacity building activities in 2014 as described below.

Figure 1: CBP domestic reach in 2014.

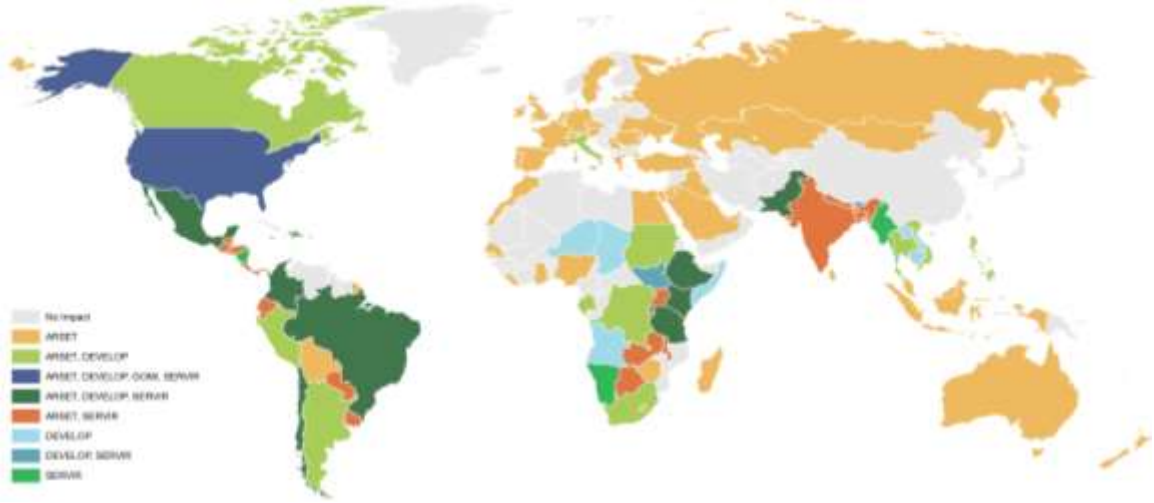

Figure 2: CBP international reach in 2014.

III. Major Accomplishments

The Capacity Building program's characterization of its impact expanded in 2014. A program-level assessment of capacity built through numbers of projects and numbers of

training events was initiated this year. In 2014, CBP collaborated with end users to conduct 97 projects through DEVELOP, SERVIR, and GOMI. In addition, ARSET conducted 11 webinars and hands-on training; SERVIR conducted 46 workshops and scientific exchanges; and DEVELOP provided 17 methodology trainings to end-users. In addition, numbers of people with a better knowledge of Earth observations and their use has begun to be collected uniformly across the program. Finally, the enhanced tracking of type and number of end users worked with was initiated in 2014 and will be integrated across the program in the future.

The program continued integrating and leveraging activities between program elements. The elements began to harmonize results frameworks and tracking indicators for the strategic plan, and collaborated in many ways. The SERVIR team helped conduct ARSET's water quality webinars in Spanish. ARSET is assisting SERVIR and one of its Applied Sciences Team projects in offering an air quality training course. GOMI is supporting SERVIR on two projects for the new Mekong hub. DEVELOP and SERVIR continued their collaboration through co-hosting a DEVELOP node at the International Centre for Integrated Mountain Development (ICIMOD) and collaborating on international projects.

The Capacity Building team continues to interact with the science community at conferences such as the American Geophysical Union Fall Meeting, where the team presented its results, chaired sessions, hosted and participated in town halls, and participated in the career lounge in addition to organizing social activities to strengthen relationships. At the Esri International Users Conference, potential users were introduced to the value of NASA data through booth presentations and a SERVIR session. Overall, CBP participated in a total of 68 conferences and 23 NASA meetings in 2014.

IV. Assessment

At the program level, CBP has begun to focus how work is done to build capacity into the approaches of workforce training and project collaborations to better identify common goals and strategies across the program elements. Levels of capacity built, targeted end users, and geographic extent have begun to be considered systematically to identify gaps and plans for the coming years.

The program continued strengthening connections to the Applied Sciences Program application areas, and to other parts of the Earth Science Division. Water issues are being discussed from basic research, applied science, and capacity building perspectives. Additional coordination across disasters areas, particularly floods, has started and will continue in 2015. The release of the Shuttle Radar Topography Mission (SRTM) 30 m data prompted coordination and collaboration with the solid Earth and Disasters programs to coordinate awareness-raising activities and upcoming training. The Capacity Building team participated in Applied Sciences applications area annual meetings, science team meetings, and mission applications workshops for impending missions. In addition, the program continued to contribute and is working to more clearly define contributions to and from international organizations including CEOS and GEO.

CBP elements strengthened their inter-relationships as well as relationships with the broader Earth science community. Initial indicators have been developed, and five year plans were considered in conjunction with the Applied Sciences Program's planning as well as planning at the program element level. As described below, each of the program elements continued to strive for and yielded improvements in the capacity they are building to use Earth observations in decision-making.

V. Program Elements and Highlights

ARSET

ARSET organized and executed 11 in-person training courses and webinars that reached 46 states and 90 countries, and more than 1,000 end users (see figure 3). The program expanded to build capacity in two new areas, water quality and land management, and established new collaborations with federal agencies, NASA-funded PIs, and NASA data centers. ARSET's ongoing end-user feedback for needs and impact assessment found that 89 percent of U.S. participants and 82 percent of international participants increased their ability to access remote sensing data products as a result of participating in ARSET. "I was able to immediately incorporate my new knowledge of accessing, analyzing, and visualizing satellite data into my day-to-day duties," said one ARSET 2014 course participant. ARSET webinars were integral to participant success in the hands-on courses, and have been made a prerequisite for hands-on courses as a result.

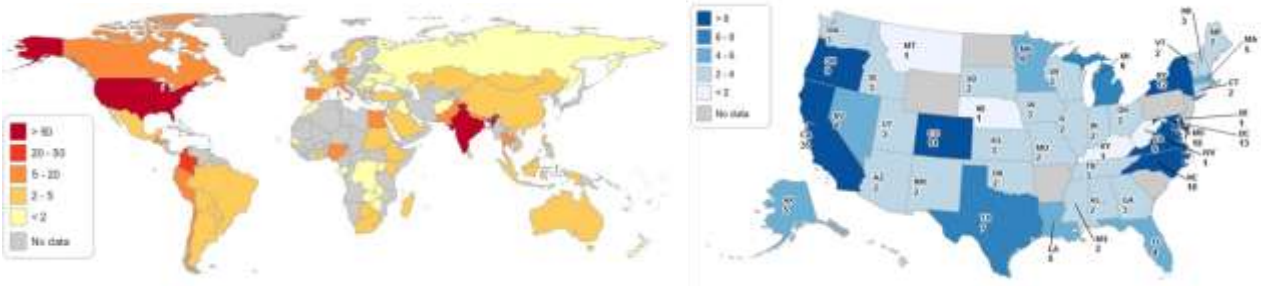

Figure 3: Number of organizations by state (U.S.) or country that participated in ARSET training in 2014.

DEVELOP

The past year was the busiest yet for DEVELOP with a total of 379 participants (representing 26 different states and the District of Columbia) working on 83 applied science projects that involved 44 states and 38 countries. The participants built their capacity to utilize Earth observations to address environmental concerns, work in teams, and expand leadership skills at 13 domestic and two overseas locations. A total of 160 partner organizations built their capacity through increased awareness and ability to use NASA Earth observations in their decision-making processes. The DEVELOP family grew with the addition of a node at the NOAA National Climatic Data Center in Ashville, North Carolina, and expanded reach in the western United States through project activity with the Bureau of Land Management and Idaho State University in Pocatello.

Figure 4: DEVELOP project reach in 2014 highlighted in green (44 U.S. states and 38 countries). States and countries that also hosted a DEVELOP node are highlighted in blue.

GOMI

GOMI continued to make major progress on three two-year projects that began in 2013, involving five states on the coast of the Gulf of Mexico. In 2014, GOMI worked with a total of 70 partners. The first project used NASA remote sensing data to develop new techniques to enhance detection of ocean oil spills. The second project began developing an application that automates the identification of impervious cover to provide accurate, up-to-date, easily accessible information that helps urban planners, real estate developers, and environmental management agencies plan effectively, monitor efficiently, and mitigate appropriately. The third project focused on providing forecasts of *Sargassum* seaweed landings on the coast of Texas to provide costal managers, business, government, and residents with alerts. GOMI continued operating the *Sargassum* Early Advisory System (SEAS) and in 2014, the SEAS team issued 100 *Sargassum* alerts with an accuracy exceeding 97 percent.

Figure 5: GOMI project reach in 2014.

SERVIR

SERVIR achieved a major milestone when it announced in October that the new SERVIR Mekong hub would be implemented by the Asian Disaster Preparedness Center and consortium partners in the Lower Mekong Basin. SERVIR-Mekong will promote the use of publicly available satellite imagery and related geospatial decision-support tools and products. These tools and products will help key stakeholders and

decision makers in Myanmar, Cambodia, Laos, Thailand, and Vietnam. This year GOMI started to support SERVIR with efforts in the Mekong region as well as in Kenya and Mauritius (figure 6). SERVIR continued to operate globally within three main regions (Central America, Eastern and Southern Africa, and Hindu-Kush Himalayas), working with 159 institutions, training more than 425 users, and carrying out 46 workshops and scientific exchanges, while reaching 44 countries. In addition, SERVIR's online product catalog was launched in early 2014, providing easier access to SERVIR applications and tools, searchable by theme, region, type, and data source (satellite sensors and other sources of data). Many highlights are captures on the SERVIR website (*SERVIRGlobal.net*). As one example, SERVIR Applied Science Team member Faisal Hossain worked with the Integrated Water Modeling Center, Bangladeshi Water Resources Ministry's research wing, to use the *Jason-2*-based flood forecasting and warning system to improve the standard flood-forecasting window from three days to eight days. The system continues to prove itself, with the Flood Forecasting and Warning Center (FFWC) expanding from three water level stations to eight during the monsoon season and planning nationwide expansion. Since June 2014, FFWC has been successfully producing the eight-day *Jason-2*-based forecasts of water levels at major river locations of Bangladesh on a daily basis and making this information available on its website and via email, fax, and text message. The eight days' advance notice is the longest lead time FFWC has ever been able to produce.

Figure 6: SERVIR projects reached one U.S. state and 44 countries; shown in purple are countries where SERVIR projects were supported by GOMI.

VI. Program Management

The Capacity Building program is managed at NASA Headquarters by Nancy Searby. Christine Lee, scientific applications engineer, supports Capacity Building and serves as a program associate for the Applied Sciences Water Resources Applications area. Sarah Hemmings addresses data access issues for Applied Sciences and Capacity Building. Merna Saad supports Capacity Building and serves as a liaison between the program elements and the management team at NASA Headquarters. Each of the NASA Center-based elements are managed by its own Center management teams.

Strategic Planning. Capacity Building continued to strengthen the program through the development of results frameworks and indicators for the program and each individual element. These are categorized into two sections: a) developing capacity within the

workforce, and b) developing capacity within decision makers. Preparing the draft results framework and potential indicators prepared the team for the NASA Applied Sciences Program Strategy and Implementation Retreat in September 2014, in Arlington, Virginia. During the retreat, program-level topics were discussed including program strategy, implementation, lessons learned, data products and access, decadal survey, and looking five years into the future. The CBP team shared best practices and brainstormed improvement ideas for the topics listed above. The outcomes of the retreat included team building as well as significant progress toward developing a five-year strategy for implementing some of the ideas discussed.

Data Access. Steps are under way to improve user awareness of and access to Earth observations data, tools, services, and training materials within the overall Applied Sciences Program as well as the Capacity Building program. Throughout 2014, we have continued to improve data discovery, access, and management. For example, the SERVIR team implemented a new Product Catalogue to make SERVIR products more accessible (*http://catalogue.servirglobal.net/*). DEVELOP had begun to make several products available on the Google Map Gallery (*https://maps.google.com/gallery/publisher?pub=DEVELOP+National+Program*). In addition, the new Applied Sciences Program website under development will improve awareness of Applied Sciences activities and provide examples of applied use of NASA data and products. Finally, a collaboration with a GEO activity called GEOCAB (Earth Observation Capacity Building Portal, *www.GEOCAB.org*) through participation in the CEOS WGCapD has the potential to provide a way to showcase NASA capacity building resources through this capacity building portal.

Application Readiness Level Tracking. The SERVIR Applied Sciences Team (AST) is tracking Application Readiness Levels (see Table 1). At the end of 2014, just over two years into the four-year projects, five projects were elevated into the validation phase (ARL 5) compared with none in 2013. The others elevated from ARL 1 and ARL 2 to ARL 3 and ARL 4 and are still in development phases.

Capacity Building Program		
SERVIR Projects		
ARL	*2013*	*2014*
ARL 9	0	0
ARL 8	0	0
ARL 7	0	0
ARL 6	0	0
ARL 5	0	5
ARL 4	2	4
ARL 3	4	2
ARL 2	4	0
ARL 1	1	0

Table 1: Application Readiness Levels for SERVIR AST projects funded by CBP in 2014.

VII. Community Leadership

In 2014, the Capacity Building program presented and led sessions in three national conferences as well as in a number of interagency and international events. Additionally, each program element provided community leadership as described in the respective sections below.

IEEE Global Humanitarian Technology Conference

The Capacity Building program participated in the IEEE Global Humanitarian Technology Conference in San Jose, California, October 10-13, 2014. The purpose of this meeting was to highlight and discuss technologies, activities, and other efforts designed to address humanitarian challenges through the development and application of innovative solutions. The humanitarian challenges addressed involve water, agriculture, energy, health, and disaster aid. Sarah Hemmings and Cindy Schmidt presented a talk that demonstrated various Earth science and Earth observations tools, resources, training materials, portals, and data/information products that can be used for environmental monitoring, and in some cases, decision making, in developing countries. The goal of the demonstration was to empower and assist the IEEE–GHTC community in utilizing Earth science information services that are freely and publicly available from NASA and its partners. Additionally, Steve Hipskind, who is the chief of the Earth Science Division at Ames Research Center, gave a keynote on efforts at NASA Ames to make Earth observations data more readily accessible to a broader community of users. More information about the meeting topics can be found here: *http://www.ieeeghtc.org/files/2012/01/Program-Booklet_web.pdf*.

AGU Fall Meeting

The Capacity Building program participated actively in the meeting in San Francisco, December 15-19, 2014. CBP chaired and/or convened three sessions at AGU and participated in presentations and poster sessions. CBP also organized a “town hall” session to provide the AGU community with an update about access to NASA Earth observations and Earth science information. Kenton Ross presented a poster about the influence of DEVELOP on workforce development. The poster summarized statistics on results and highlighted participant success stories. In addition, the DEVELOP team participated in the Career Lounge. At AGU, officials from Bangladesh announced that they are expanding use of a satellite-based flood forecasting and warning system developed by SERVIR. The system, which relies on river level data provided by the *Jason-2* satellite, last year provided the longest lead time for flood warnings ever produced in Bangladesh.

Esri International User Conference

The Capacity Building program participated in this conference in San Diego, July 14-18, 2014. ICIMOD, SERVIR-Himalaya’s regional host organization, received the Special Achievement in GIS Award at the conference for its vision, leadership, hard work, and innovation in geospatial technology. Additionally, the SERVIR-Himalaya team led two technical sessions providing an environmental showcase and demo theaters, and contributed to special exhibits in the Map Gallery. The SERVIR Coordination Team presented the SERVIR story via a NASA hyperwall for demonstrating eye-catching

satellite images of our planet, which are useful to environmental decision makers. And finally, CBP participated in the ESD booth to share information regarding DAACs and data access with the many participants of this conference.

Interagency Meetings
Capacity Building built awareness of the overall program and its elements at a number of major meetings with U.S. government agencies. These meetings included the USGEO IAWG monthly meetings and SERVIR Joint Working Group with USAID. Highlights include representing NASA's support to GEO's water and overall capacity building activities at the USGEO Workshop on GEO Activities held April 1-2, 2014, in Reston, Virginia, and engaging Latin American embassies to build awareness of GEO and the Americas Caucus at the Embassy Dialogue held August 6, 2014, in Washington, D.C.

NASA continued to work with the U.S. Water Partnership on water activities. CBP participated in the Water Partnership Launch of the H2infO Web Portal (*www.h2info.us*) at the State Department George C. Marshall Center. The platform currently hosts more than 3,000 resources from leading U.S.-based institutions, and has so far been accessed by users in 38 countries. The launch event also featured exhibits and hands-on demonstrations from NASA's David Toll and Sarah Hemmings highlighting water activities including *GPM*, *SMAP*, and SERVIR. NASA will continue to assist with the further development of H2inO other U.S. Water Partnership initiatives.

One highlight that occurred as a result of the USWP work is the initiation of a pilot project between NASA, Skoll Global Threats Foundation, and ICIMOD, implemented by Ben Zaitchik of Johns Hopkins University, to begin the development of a South Asia Land Data Assimilation System to support Indian water resources managers through WRI's India Water Tool as well as ICIMOD users engaged through SERVIR-Himalaya.

VIII. International Activities

The Capacity Building program actively participated in U.S. and international Earth observations and capacity building activities in 2014. CBP supported a wide variety of activities engaging Central and South American organizations and government agencies, including the Centre of Hydrologic and Spatial Information for Latin America and the Caribbean (CIEHLYC) webinar series, Latin American Geospatial Forum, GEO Americas Caucus Meeting, and USGEO GEOSS in the Americas Coordination Group monthly meetings. In addition, Nancy Searby, Capacity Building program manager, serves as the co-chair of the USGEO GEOSS in the Americas Coordination Group, and organized NASA support of this activity in concert with USGEO and GEO colleagues. Nancy Searby also serves as the NASA representative on the GEO water capacity building task team and the CEOS Working Group for Capacity Building and Data Democracy (WGCapD) and continued to support water related activities.

As a member of GEO, CBP participated as part of the U.S. delegation at the Americas Caucus meeting held October 9-10, 2014 in Bogota. At this meeting, participants

agreed on areas needing additional focus: agriculture, water resources, ecosystem monitoring, and capacity building.

SERVIR and WGCapD collaborated to provide the newly released data on physical storage devices to 20 countries at the Regional Centre for Mapping of Resources of Development (RCMRD) 2014 Conference of Ministries that occurred November 10-19, 2014, in Addis Ababa. SERVIR also provided additional data to the African Earth Observation community (AfriGEOSS) through the CEOS team at the GEO-XI Plenary that occurred November 13-14, 2014, in Geneva, Switzerland.

The Capacity Building program participated in the Great Lakes and Water Quality Workshop in Cleveland, Ohio, which took place March 12-13, 2014, with both U.S. and Canadian attendees. At the event, Earth observations data and aircraft capabilities were highlighted. A discussion took place to brainstorm potential ideas for future projects that addressed water quality in that region.

CBP continued to build awareness for NASA's water projects across basic research, applied sciences, and capacity building through collaboration with the World Bank in a number of activities including training, regional capacity building initiatives, sharing new development and best practices, and developing water portals. Through the collaboration with NASA and other agencies such as NOAA, the World Bank continued to develop the "Spatial Agent" mobile application, which is intended to provide high-quality data sets available to be used for resource management, public health, and other fields. The goal of this initiative is to improve data transparency and open data platforms.

To help understand and assess international activities, CBP started to assess international activities by GEO Caucus to identify nations that have benefited most from CBP capacity building. SERVIR was able to engage many countries through the support of the regional hubs. Also, DEVELOP reached several countries by working with partners there. In addition, ARSET enabled participation from a record number of countries through its online courses; 90 countries in total participated in ARSET online training. And finally, GOMI continued to work within the United States. Maps below highlight CBP activities in three regions, including charts that demonstrate activity based on Applies Sciences applications areas. In the Americas, the focus has been on water resources, ecological forecasting, and disasters. In Africa, the focus has been on ecological forecasting and water resources. In Asia and Oceana, the focus has been on water resources and ecological forecasting, and to lesser extent on disasters and air quality. ARSET online training also reached Europe and the Commonwealth of Independent States in 2014.

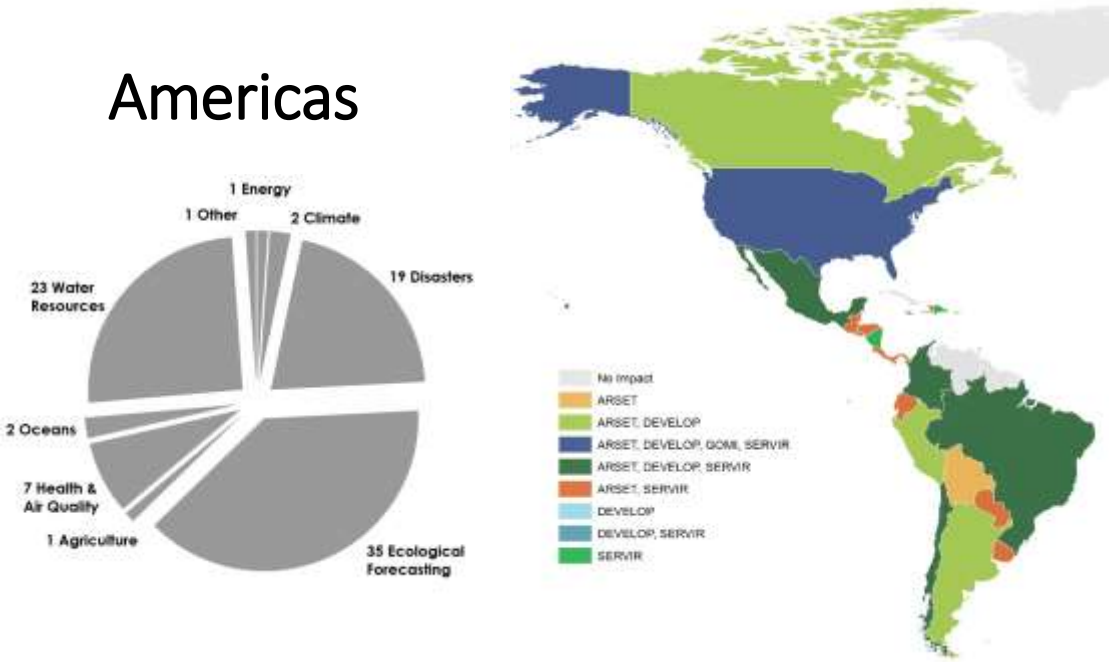

Figure 7: The map on the right shows CBP elements activity reach within the Americas. The chart on the left shows the breakdown of CBP activities by applications area.

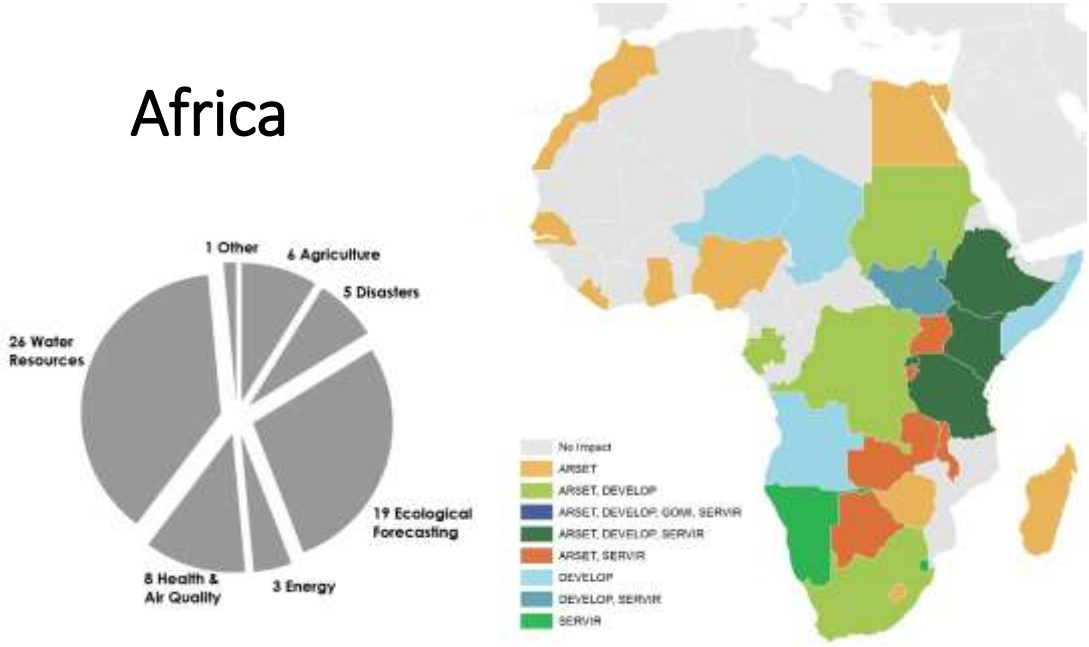

Figure 8: The map on the right shows CBP element activity reach in Africa. The chart on the left shows the breakdown of CBP activities by application area.

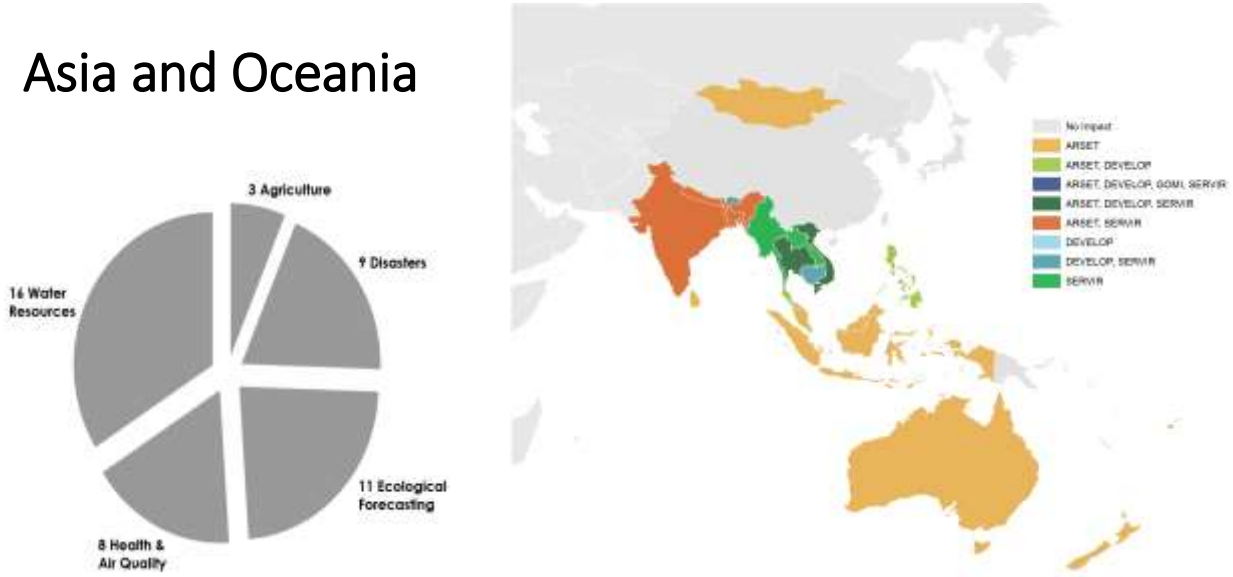

Figure 9: The map on the right shows CBP element activity reach in Asia and Oceania. The chart on the left shows the breakdown of CBP activities by application area.

IX. Looking Ahead

In 2015, the Capacity Building program looks forward to building on progress accomplished at the Applied Sciences Retreat and completing its five-year strategic plan. CBP will continue to collect feedback and evaluate challenges in using Earth science data, products, and tools, and conceive of ways to make them more known and accessible. The program will continue to find ways to strengthen engagement with science and applications to increase international and domestic capacity building activities, as well as work with boundary organizations that can help increase reach through organizations' previous engagement with key end-user groups. In addition, CBP will continue to explore new partnerships and build awareness regarding Earth science assets and their usefulness to address environmental issues in the United States and abroad. The Capacity Building program will continue to address and refine indicators to track progress and impact at the program as well as element level, and targets to guide the program. And finally, Capacity Building management will continue to work with the program element teams to ensure that they have the resources to continue to their mission and do great work, and to integrate and benefit from each other's work.

X. Appendix

Program Element Highlights

ARSET

ARSET provides professional training in the application of NASA Earth Science data for water resources, disasters, land, and health/air quality management. The goal of the program is to build the skills to integrate NASA Earth science into agencies' decision-making activities. The program works directly with agencies and policy makers to develop in-person and online training courses that teach end users how to access, visualize, and apply NASA Earth science data in their professional areas.

Key Accomplishments in 2014

- Conducted 11 in-person trainings and webinars, reaching a record number of organizations representing over 1,000 end users, 184 countries, and 650 institutions.
- Webinars were key to the expansion of ARSET's international reach. End users also reported that attending webinars prior to hands-on training greatly enhanced the value of the hands-on training experience.
- For the first time, ARSET conducted a Water Quality webinar fully in Spanish for end users in Latin America.
- Expanded its portfolio to include webinars in land management.
- Conducted hands-on training for air quality applications in collaboration with EPA and the Texas Commission on Environmental Quality.
- Supported 14 NASA Earth Science Division events, including science team meetings.

Water Resources and Disaster Management Accomplishments

- Collaborated with EOSDIS to provide a broad overview training in NASA data sets and tools available from all the NASA DAACs. The goal was to reach end-user communities previously not exposed to remote sensing data.
- Facilitated future international development-related engagement by conducting an introductory training at the USAID GeoCenter with participants from the Global Development Lab/GeoCenter and the Economic Growth, Education, and Environment/Water Office.
- Provided a webinar to the National Integrated Drought Information System Engaging Preparedness Communities as part of webinar series on remote sensing data for drought monitoring and preparedness.
- Developed the first training on remote sensing of water quality in coastal oceans, estuaries, and lakes, in collaboration with EPA and SERVIR.

Air Quality Accomplishments

- Completed the ARSET 2009–2014 impact assessment, which found that 89 percent of U.S. participants and 82 percent of international participants increased their ability to access remote sensing data products as a result of taking an ARSET air quality

training. ARSET enabled the use of NASA data for decision support applications, in particular for forecasting and exceptional events.
- Responded to regional training needs in the Indian region by conducting a webinar entitled “Introduction to Remote Sensing for Air Quality Applications for the Indian Sub-Continent and Surrounding Regions.” Due to overwhelming interest, an in-person air quality training will be provided for Nepal and surrounding countries in June 2015.

Ecological Forecasting Accomplishments
- Developed first two webinars on remote sensing for land management applications.
- Ninety-five percent of survey respondents indicated an improved understanding of how remote sensing data products can be used for environmental monitoring and decision making for ecological land applications. Over 80 percent expressed interest in attending future webinars or in-person trainings.
- Webinars included guest speakers from the Land Processes Distributed Active Archive Center.

	Water Resources and Disasters Management	Air Quality	Eco Forecasting and Land Management	Total
Number of attendees	555 (542)	175 (175)	284 (284)	1,014 (927)
Number of organizations	373 (343)	80 (78)	197 (189)	650 (533)
Number of states	79 (44)	10 (7)	56 (38)	145 (46)
Number of countries	109 (81)	23 (20)	52 (43)	184 (90)
Number of webinars	3	2	2	7
No. of hands-on training events	2	2	0	4

Table 2: Statistics of ARSET activities with unique participation in parenthesis.

DEVELOP National Program

Full report available upon request.

DEVELOP addresses environmental management and public policy issues through interdisciplinary research projects that apply the lens of NASA Earth observations to community concerns around the globe. Serving as a bridge between NASA Earth science and society, DEVELOP builds capacity in both participants and partner organizations to better prepare them to handle the challenges that face our society and future generations.

The past year was a pivotal year for DEVELOP, setting a record for highest number of participants and projects to-date (see table 3). A total of 379 participants conducted 83 projects at 15 locations (13 in the United States, two international locations in Mexico and Nepal). The 83 projects partnered with 160 unique end-user organizations that could benefit from enhanced decision-making tools. A partnership with NOAA set the foundation for the newest node opening in Asheville, North Carolina at NOAA's National Climatic Data Center.

Statistics
379 participant opportunities awarded
15 locations hosted DEVELOP activity
83 applied sciences projects partnered with 160 unique end-user organizations

Year	2011	2012	2013	2014
Projects	54	69	78	83
Participants	259	337	348	379
Locations	11	14	16	15

Table 3: The number of DEVELOP projects and participants has continued to grow over the last four years.

Key Accomplishments in 2014

- Throughout 2014, DEVELOP participants presented and participated in 37 science and policy conferences and contributed to 21 NASA meetings and workshops.
- The new DEVELOP online application system went live on January 20, providing an entirely paperless process for summer application collection and review.
- A new DEVELOP node opened in Asheville, North Carolina, hosted by NOAA's National Climatic Data Center.
- DEVELOP took on a new initiative to engage active duty service members, transitioning and retired military, and veterans in the program. An inaugural group of 24 active duty service members volunteered at Langley Research Center to kick off the initiative in 2014. Through this interaction, the active military members have brought their skills to the projects, and have had the opportunity themselves to learn about NASA EOS applications.
- DEVELOP chaired two special sessions: one at the ASPRS Annual Conference in Louisville, Kentucky, and the second at the SEDAAG Annual Meeting in Athens, Georgia.
- Jason Jones received the NASA Langley Center Director's Award for outstanding contributions to NASA and the DEVELOP National Program on March 5.
- Amber Kuss received the 2014 Ames Honor Award in the student category and was presented with the award by the NASA Ames Center Director, Pete Worden, on July 23.

- DEVELOP received an eLearning! 100 Award in recognition of excellence in learning across enterprises that invest in a truly immersive learning culture and enabling a learning culture that creates outstanding organizational performance.
- DEVELOP collaborated with SERVIR's My Community Our Earth (MyCOE) Program, pairing up a DEVELOP project team at Goddard with Vietnamese MyCOE fellow Nguyen Minh Khoa and his advisor, culminating in a capstone event at NASA Headquarters in April.
- Chile's CIREN sponsored DEVELOP to travel to Santiago, Chile, to conduct a three-day training workshop to hand off project results and methodologies from the Langley DEVELOP Chile Water Resources project in October.
- DEVELOP had a strong American Geophysical Union (AGU) presence with three oral presentations, seven poster presentations, a presentation at the NASA booth, a presentation at the AGU Career Lounge, and an Ignite talk.
- DEVELOP partnered with *Earthzine* to host three Virtual Poster Sessions – spring (March 30), summer (August 4) and fall (November 22) – with a total of 83 videos demonstrating the application of NASA Earth observations.

Gulf of Mexico Initiative

GOMI creates innovative tools that enable people to easily use Earth science data to address environmental and societal challenges. The program began to help the Gulf Coast recover from the devastating hurricanes Katrina and Rita. After completing 48 GOMI ROSES projects in 2013, GOMI refocused on three main projects in 2014 including the detection of oil spills, the identification of impervious cover, and the automation forecasts of *Sargassum* seaweed landing on coasts. In addition, GOMI continued to track the benefits of those projects to address coastal zone problems across the globe and to apply the lessons learned from GOMI, user feedback, and industry best practices to increase the capacity of individuals and organizations to apply Earth science to coastal zone problems.

Key Accomplishments in 2014:

- Due to heavy landings across the Gulf of Mexico, the *Sargassum* Early Advisory System (SEAS) team expanded its forecast area to include Louisiana, Mississippi, Alabama, and Florida, increasing the monitoring area by 1,200 square miles.
- GOMI created and automated a new ocean oil spill detection algorithm that does not rely on sun glint.
- GOMI validated the new ocean oil spill detection algorithm using confirmed sightings while participating in a multi-agency disaster response team.
- The Impervious Cover App team integrated an ensemble of algorithms into a decision tree to enhance automated classification of impervious cover and began beta testing by the Mobile Bay National Estuarine Program.

GOMI Projects Summary

The SEAS project provides coastal managers, businesses, governments, and residents with alerts of potential landings of *Sargassum*. In 2014, the Gulf Coast was repeatedly

inundated with vast quantities of seaweed. Coastal communities economically dependent upon tourism looked for information to help them minimize this problem. The SEAS team issued 100 *Sargassum* alerts in 2014 and created state-of-the-art algorithms to automatically detect *Sargassum* in *Landsat* imagery. Thanks to an accuracy exceeding 97 percent, the SEAS alerts provide users with crucial information that help optimize the scheduling and budgeting of scarce resources to remove or reposition the seaweed away from beaches frequented by tourists.

The Impervious Cover App project began the development of a tool to provide users with custom, on-demand information about impervious cover—the buildings, roads, parking lots, etc. that prevent the ground from being able to absorb rainfall. Small changes in impervious cover can have a significant effect on urban heat islands, urban flooding, water quality, aquatic ecosystems, and associated conservation and restoration projects.

This application will provide accurate, up-to-date, easily accessible information that helps urban planners, real estate developers, and environmental management agencies plan effectively, monitor efficiently, and mitigate appropriately.

The Enhanced Oil Spill Detection project addresses a critical weakness in oil spill response. NASA satellite imagery can be used to detect ocean oil spills using sun glint; however, this only occurs during certain times of the year. New algorithms are being developed that enable year-round detection of ocean oil spills using free NASA data. A partnership with NOAA will transition these new capabilities into operational use once the algorithms are completed.

In addition, GOMI has also started to work on the development of an NDVI/Impervious cover product for Cambodia, Laos, Vietnam, Thailand, Myanmar, Kenya, and Mauritius in support of SERVIR's Mekong hub. GOMI is also working on generating a suspended sediment product for the Lower Mekong River region.

SERVIR Annual Report 2014 Summary

Full report available upon request.

SERVIR is a NASA–USAID venture that enables applications of Earth observations to help developing countries assess environmental conditions, climate change, disasters, health, and other issues to improve their planning, decisions, and actions. SERVIR works with regionally-based, multinational organizations with mandates to provide and enable use of geospatial and scientific information by governments and regional entities. The project identifies stakeholder concerns; designs projects based on end user needs; performs applications feasibility testing, deployment, and evaluation; strengthens technical and other capacities of regional institutions; increases availability of data and information products; improves decision tools; and communicates application innovations.

Indicator # Description	2014 Actual
Indicator 1-1 Number of stakeholders using climate information in their decision making as a result of USG assistance	163
Indicator 1-2 Number of stakeholders receiving training as a result of USG assistance	427
Indicator 1-3 Number of institutions engaged in regional or global knowledge exchange through SERVIR	159
Indicator 2-1 Number of data layers standardized and made accessible	59
Indicator 2-2 Number of regional stakeholders co-developing climate mitigation or adaptation tools	35
Indicator 2-3 Number of climate mitigation tools developed with USG help	21
Indicator 3-1 Funding leveraged from public and private sources as a result of USFG assistance ($M)	0
Indicator 3-2 Number of scientists or decision makers participating in exchanges between SERVIR hubs or partner institutions	130
Indicator 3-3 Number of institutions with improved capacity to address climate change issues as a result of USG assistance	99

Table 4: SERVIR results for the project's indicators in 2014.

Key Accomplishments in 2014

- SERVIR innovations in African and Hindu Kush-Himalayan countries include land cover mapping, flood and drought monitoring, forecasting systems, and more.
- SERVIR's online product catalog was launched in early 2014, providing easy access to SERVIR applications and tools searchable by theme, region, type, and data source (*http://catalogue.servirglobal.net/).*
- SERVIR-Eastern and Southern Africa (SERVIR-E&SA) held training workshops throughout 2014 to disseminate land cover maps for Malawi, Rwanda, Zambia, and Namibia to support the countries' greenhouse gas inventories, and created a dynamic viewer with which users can see the differences between land cover types of different time periods and schemes of classification by swiping between different data sets.
- SERVIR developed maps to help stakeholders identify biological corridors, quantify their carbon stocks, formulate conservation plans, and reduce CO2 emissions.
- SERVIR's capacity building activities included the Washington, D.C., MyCOE/SERVIR Capstone gathering on April 3-4, which sponsored 14 young innovators engaged in geospatial technology-based environmental research.
- SERVIR international hub team members and associates from Africa, the Hindu Kush-Himalayas, and Mesoamerica traveled across the globe to meet with their U.S. counterparts for the Esri International Users Conference in San Diego, California, July 13-18, 2014. The SERVIR Coordination Office team presented the SERVIR

story via the NASA hyperwall, a set of nine high-resolution screens combined to form a large display, and the International Centre for Integrated Mountain Development (ICIMOD), SERVIR-Himalaya's regional host organization, received a Special Achievement in GIS Award at Esri for its vision, leadership, hard work, and innovation in use of geospatial technology.

- A first-of-its kind Bhutan National Geospatial Portal was formally launched on October 13 by the queen of Bhutan. The new portal will serve as a gateway for people across Bhutan to access all kinds of spatial and geographical data related to Bhutan. Anyone with an Internet connection can now find maps showing locations of fires within Bhutan on various dates between 2000 and 2013; national parks, nature reserves, and biological corridor networks of Bhutan; locations of hydropower plants that are existing, planned, and under construction; and more. The portal was built with support from ICIMOD under the framework of SERVIR-Himalaya.
- The kickoff for a new SERVIR hub for the lower Mekong region was held October 30-31, in Bangkok. SERVIR-Mekong, hosted by the Asian Disaster Preparedness Center and its partners, joins SERVIR-Eastern and Southern Africa, SERVIR-Himalaya, and continuing activities in Central America as part of the SERVIR network. SERVIR-Mekong will promote use of satellite imagery to help Myanmar, Cambodia, Laos, Thailand, and Vietnam better predict and cope with floods and other natural disasters and increase resilience to the negative effects of climate change.
- NASA Administrator Charles Bolden traveled to Ethiopia on November 10 to meet with African National Mapping Directors and Regional Center for Mapping of Resources for Development (RCMRD) leadership and provide them with 30-m SRTM data for their use in improving assessments of flood risks in Africa. Discussions were also held about progress in and future opportunities for NASA Capacity Building activities in the region.
- At the AGU Fall Meeting, officials from the Bangladesh Flood Forecasting and Warning Center (FFWC) Bangladesh announced that they are expanding use of the SERVIR-developed *Jason-2* satellite-based flood forecasting and warning system nationwide. Last year, the system, which relies on river level data provided by the *Jason-2* satellite, provided the longest lead time (eight days) for flood warnings ever produced in Bangladesh.
- SERVIR implemented an online viewer for improved access to view and download imagery from the ISERV camera. Users can view and download a specific or multiple ISERV scenes from more than 2,000 images (*http://www.servirglobal.net/mapresources/iserv*).

SERVIR Applied Science Team Projects Summary

SERVIR has many ongoing projects with SERVIR regional hubs, and more information about them can be found in the SERVIR product catalog. A summary of the 11 SERVIR AST project progress is included below.

Development and Implementation of Flood Risk Mapping, Water Bodies Monitoring, and Climate Information for Disaster Management and Human Health
Principal investigator: Pietro Ceccato, Columbia University
This project is developing the capacity to integrate NASA remotely-sensed products for establishing an improved vector-borne disease risk assessment tool for use by targeted stakeholders. The project team has developed water bodies mapping techniques and held several successful trainings with end users and ministries in East Africa. They have trained SERVIR-E&SA personnel in vector-borne disease modeling and mapping with the goal of incorporating International Research Institute Malaria risk data (rainfall and water bodies) in RCMRD and SERVIR Web portals. Additional training will build the technical capacity of ministry staff and other national stakeholders for carrying out context-based analysis of climate data and trends over Zambia or specific regions, and relating that to health data and information collected by the ministry at community/facility level (data contained in the District Health Information Software). The other products developed in the AST project led by Ceccato include:

- Inundations derived from passive microwave on global scale at 25 km spatial resolution.
- Water bodies and turbidity derived from *Landsat* and MODIS.
- Precipitation, temperature, vegetation, vectorial capacity model for Africa.
- Precipitation forecast (six days) on global scale for International Federation of Red Cross and Red Crescent.

East Africa Drought and Agricultural Productivity Assessment and Prediction System
Principal investigator: Stephanie Granger, Jet Propulsion Laboratory
This project informs farming practices in East Africa by helping farmers adjust the timing of their crops, and also informs food security decisions at the ministry level using Earth observation data. Since its inception, the project has coupled the Variable Infiltration Capacity (VIC) and Decision Support System for Agrotechnology Transfer (DSSAT) models for several crop type modules and begun working with another AST project's downscaled climate scenarios. A valuable linkage with RCMRD has provided crop data useful for model calibration efforts, and trainings on the project's tools are ongoing. The maize model for DSSAT was completed last year. As inputs for the model, which estimates maize crop yield, a subset of an unprecedented 30-year daily rainfall time-series grid for the African continent was created by another AST project. In addition:

- Training on DSSAT was provided to RCMRD and to staff from the Kenyan Department of Resource Surveys and Remote Sensing.
- The Regional Hydrological Extremes Assessment System assimilation framework, which links DSSAT and VIC, is complete and tested. A prototype system, including the data management system, has been developed and was demonstrated at RCMRD.
- Additional requirements from stakeholders were gathered and a schedule to meet them was also planned.
- Data sets for different weather parameters such as solar radiation and evapotranspiration are being generated. Calibration and validation will become a

part of the products.

A Long Time-Series Indicator of Agricultural Drought for the Greater Horn of Africa

Principal investigator: James Verdin, United States Geological Survey

This project creates a long time-series indicator of agricultural drought in the Greater Horn of Africa using remotely sensed observations. Since its inception, this project has generated a 30-year rainfall data set (1981 to present) using a variety of available satellite data and model products, as well as information from RCMRD. Main outputs include an approximate 30 year time series of daily rainfall grids at 0.05 degree resolution for Africa and a water requirement satisfaction index (WRSI) as a long time-series indicator of agricultural drought. Accomplishments include:

- Completion of an initial 30-year CHIRPS-gridded rainfall time series for Africa.
- A CHIRPS rainfall data Web interface at the University of California Santa Barbara using the Early Warning eXplorer.
- GeoCLIM and GeoWRSI software for CHIRPS applications were introduced, in particular at a workshop held with the Intergovernmental Authority on Development Climate Prediction and Applications Center, which brought together participants from the East Africa Community, Kenya, Uganda, Tanzania, Burundi, and Rwanda.
- The data from this effort are being used by the CHIRPS and NDVI analysis tool for the USAID Senegal effort.

SERVIR Water Africa-Arizona Team (SWAAT)

Principal investigator: Juan Valdes and Aleix Serrat-Capdevila, University of Arizona

This project develops applications and capabilities to monitor water resources availability in Africa, provides near-term streamflow forecasts in three key pilot basins (Mara, Tekeze, and Zambezi), and provides a quantitative assessment of climate change effects on water resources in the selected basins. Products produced by other AST members will be employed to create consistent climate scenarios for water resource management uses. Accomplishments include:

- Three streamflow simulations, including VIC, HyMod, and Hydrologiska Byrans Vattenbalansavdelning models, are now running in real time, pulling data from Tropical Rainfall Measuring Mission, CPC MORPHing technique, Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks, and CHIRPS rainfall products. These currently cover the Mara basin and Upper Zambezi basins.
- Calibration and validation efforts have shown that a soil and water assessment tool model has mimicked fairly the seasonality of observed flow of the Nyangores River in Bomet. Validation of the other models is ongoing.
- RCMRD has played a strong role in connecting the AST researchers to management agencies in Kenya, organizing workshops, and facilitating ground validation data. In June and July, RCMRD hosted a workshop that brought together stakeholders and researchers to discuss hydrologic forecasting efforts, dealing with uncertainty, characterizing decisions made in the water management cycle, the implications for tools and forecast design, and synergies with other projects.

Forest Carbon Assessment for REDD in the East Africa SERVIR Region
Principal investigator: Scott Goetz and Nadine Laporte, Woods Hole Research Center
This project demonstrates that NASA Earth science products and derived models can assist stakeholders and decision makers with their terrestrial carbon assessment and forest conservation strategies. This year, RCMRD supported the project team in developing a training workshop to estimate carbon as part of the AST project Forest Carbon Assessment for Reducing Emissions from Deforestation and Forest Degradation (REDD+) in the SERVIR-E&SA Region. SERVIR-E&SA greenhouse gas (GHG) team members received the training as well. In addition, the project team worked with the Zambia Forest Department on emission changes and uncertainty mapping and using new forest cover data to estimate GHG emissions. The team also used NASA Earth observation satellite data to map biological corridors across the tropics. The results revealed that many such corridors are as rich or richer in vegetation and forests as the protected areas they connect. In providing such information to East African countries, this project has revealed that biological corridors are worthy of special focus in conservation efforts for many reasons. In addition, SERVIR E&SA is collaborating with this project to develop in-house capacity on REDD+ related topics. An example of this is the workshop (mentioned above) on the use of open source code to process satellite data to estimate carbon.

Mesoamerica and Cross-regional
There are four AST projects that are for the SERVIR-Mesoamerica region or are cross-regional in their applications. The projects engage in the areas of REDD+ policy making, Climate Change, Landslide Hazard Assessment and Forecasting, and Air Quality.

Using Earth Observation Data to Improve REDD+ Policy in Mesoamerica and the Dominican Republic
Principal investigator: Allen Blackman, Resources for the Future
This project improves the efficiency and effectiveness of REDD+ policy making in Mesoamerican countries using *Landsat* and MODIS data to characterize forest cover change and combine this with geophysical, institutional, socioeconomic, and ecological characteristics to develop a Web-based decision tool. Two main objectives of this endeavor are to create a targeting tool and an evaluation toolkit. The targeting tool is designed to help guide where forest conservation policies should be sited. The evaluation toolkit will help assess the effectiveness of specific existing forest conservation policies in stemming deforestation. Both the tool and toolkit are designed to be Web-based and interactive. This year, the team:

- Developed basic tool architecture using a desktop computer as a server and populating it with data for six REDD+ pilot sites in Mexico. This supported a USAID MREDD project and received praise from the Nature Conservancy, which is the technical implementing agency. For the rest of Central America, the team put together placeholder data on deforestation risk, biodiversity indicators, hydrological services, and carbon data. In August 2014, they visited potential end users in El Salvador, Costa Rica, and Panama, gaining feedback on a prototype system.
- Assembled most of the requisite data for the evaluation toolkit, published a “how-to” manual, and identified potential case studies.

- Kept abreast of ongoing REDD+-related efforts in the region, particularly through the USAID-funded Regional Climate Change Program, among others.

Leveraging CMIP5 and NASA/GMAO Coupled Modeling Capacity for SERVIR East Africa Climate Projections

Principal investigator: Franklin "Pete" Robertson, NASA Marshall Space Flight Center

This project critically assesses and employs climate model projections of seasonal and inter-annual hydro-meteorological climate variability affecting SERVIR hub regions, and develops and refines scenarios through downscaling and stochastic modeling to enable other AST investigators to drive decision support systems on seasonal time horizons. The project focuses on developing climate scenarios tailored to the unique geographic and thematic needs and requirements of many AST projects. Of particular emphasis are seasonal forecasts and multi-decadal simulations for SERVIR regions. FY 2014 accomplishments include the following activities:

- Enhanced seasonal precipitation outlooks were obtained by incorporating large-scale sea-surface temperature and precipitation simulations in the U.S. National Multi-Model Ensemble. CHIRPS data were among the inputs included.
- Statistical significance skills for seasonal amounts and frequency of rainfall were calculated for observed and predicted data sets. Overall, higher skill was achieved during October-December than March–May seasons. These skill scores will come to bear in upcoming AST project applications.
- Integration with the USAID PREPARED climate adaptation program was coordinated through Chris Funk (co-investigator on Robertson's SERVIR AST project and on Jim Verdin's SERVIR AST project, *Long Time-Series Indicator of Agricultural Drought for the Greater Horn of Africa*), particularly through travel to Arusha, Tanzania, and Nairobi. Funk worked closely with East African Community scientists in their productions of 1981–2013 grids of monthly precipitation, allowing them to analyze climatological risk and examine precipitation trends.

Landslide Hazard Assessment and Forecasting System Using Near Real-time Remote Sensing Information over SERVIR-Mesoamerica

Principal investigator: Dalia Kirschbaum, NASA Goddard Space Flight Center

This project is developing a Central American landslide hazard forecasting system using satellite data to assess regional landslide hazards and provide probabilistic landslide alerts for real-time and forecasted landslide activity, then transferring this system to interested stakeholders with training and feedback gathering in an effort to provide landslide "alerts" on a publicly accessible map-based server. Since its inception, this project has conducted a soil and lithology survey to aid susceptibility characterization, developed a model definition document circulated to hub participants, and begun developing the online landslide model infrastructure for a Web-based open source system. Accomplishments include:

- Global rainfall-triggered landslide inventory (*http://ojo-streamer.herokuapp.com/*).
- Central America landslide monitoring and forecast system in beta, based on data gathered from surveys sent to experts in Central America, combined with satellite and *in situ* data on landslide susceptibility (*http://ojo- streamer.herokuapp.com/meso*).

- Built system architecture for open source release in 2015.

Applications of Satellite Products for Air Quality Monitoring, Analysis, Forecasting, and Visualization in the SERVIR Mesoamerica and Himalaya Regions
Principal investigator: Amy Thomas, Battelle Memorial Institute; Amy Huff, Pennsylvania State University
This project is developing high resolution regional aerosol satellite products and national air quality modeling systems for El Salvador and Costa Rica, as well conducting training and outreach. It is also conducting a regional scoping survey and inventory and developing a quantitative method to track sources of transboundary air pollution in the HKH region. Previously, the project developed and released a website to visualize aerosol satellite products for Mesoamerica, developed experimental versions of the Community Multi-scale Air Quality modeling system for El Salvador and Costa Rica, held a highly successful workshop in Panama focused on communicating air quality information based on a recent landfill fire event that was very relevant to the stakeholders present, and began planning for a workshop in the HKH region in Spring 2015 leveraging ARSET capabilities to enhance success. This FY, accomplishments in Mesoamerica and the HKH region included the following:

- A beta version for a MODIS satellite visualization website for Mesoamerica was created, showing true color and aerosol optical depth (AOD). The provision of AOD at a 3 km resolution represents a higher resolution than readily available through other sources. Stakeholder feedback will be gathered through a regional advisory group (*http://servir-aq.dnsdynamic.net/*).
- National air quality models in Costa Rica and El Salvador have made progress through the documentation of procedures and collection and formatting of model inputs.
- An outreach and capacity building workshop on air quality communication was held in Panama.
- AST principal investigator Amy Thomas of the Battelle Memorial Institute participated in a workshop in June hosted by ICIMOD in the Pokhara region. During this event, information was collected on the needs and interests of end users and available ground data was also collected.
- A beta version of a visualization website has been created for the HKH region and shared with HKH stakeholders (*http://servir-aq.dnsdynamic.net/himalaya.php*).
- ICIMOD plans to leverage its MODIS receiving antenna and existing geospatial platforms to facilitate the transition of AOD products to the ICIMOD geoportal to make them available to all end users.

Himalaya
There are two AST projects exclusively for the SERVIR-Himalaya region, but two other projects previously mentioned also participate in the same thematic area. The projects engage in the areas of Flood Resources Mapping and Visualization, Glacier and Alpine Hazards, Landslide Assessment, and Air Quality.

A Satellite-based Early Warning, Mapping and Post-Disaster Visualization System for Water Resources of Low-lying Deltas of the Hindu Kush-Himalayan Region

Principal investigator: Faisal Hossain, Tennessee Technological University

This project plans to prototype a modular satellite-based water resources and water hazard mapping, early warning and post-disaster assessment visualization system for use by stakeholders in the Ganges-Brahmaputra-Meghna and Indus basins. It also will test the system's accuracy in close collaboration with stakeholders and build capacity in the region. In addition, the project will provide feedback on data accuracy for NASA's planned Global Precipitation Measurement and Surface Water Ocean Topography missions. The project team worked with the Integrated Water Modeling Center, Bangladeshi Water Resources Ministry's research wing, in using the *Jason-2*-based flood forecasting and warning system to improve their flood-forecasting window from three days to eight days. The system continues to prove itself, with the Flood Forecasting and Warning Center (FFWC) expanding from three stations to eight during the monsoon season and planning nationwide expansion. Key FY 2014 activities are listed below:

- Since June 2014, FFWC has been successfully producing the eight-day *Jason-2*-based forecasts of water levels at major river locations of Bangladesh on a daily basis and making this information available on their website. The eight days advance notice is the longest lead time FFWC has ever been able to produce.
- ICIMOD's Regional Database Initiative Lead traveled to the University of Washington for training in VIC modelling. The intent is for SERVIR-Himalaya to develop the expertise to support FFWC as well as replicate the Flood Early Warning System in other regions.
- Amirul Hossain of the FFWC presented at the 2014 AGU Fall Meeting on the success of SERVIR's *Jason-2*-based flood forecasting system in Bangladesh and announced FFWC's intention to expand *Jason-2*-based forecasting system nationwide.

Interdisciplinary Science Applications to Glacier and Alpine Hazards in Relation to Development and Habitation in the Hindu Kush-Himalaya

Principal investigator: Jeffrey Kargel, University of Arizona

This project creates a satellite image time series of glacier lakes, conducts topographic and hydrological analysis, performs field studies of glacier lakes, designs a conceptual warning system, and assesses a recent disaster of critical importance to the people of Nepal (Seti River disaster, 2012). The project team engages with important regional stakeholders and conducts training and capacity building in the region. In the past, the project team has embarked on several key field studies of priority glacier lakes identified by HKH stakeholders, determined degradation and stability of the Thulagi Lake damming moraine, and identified potential hazards that could affect downstream communities. The project has also held technical training workshops and collaborated with SERVIR-Himalaya hub organization ICIMOD to develop a scientific publication on glacier dynamics using ICIMOD's glacier database. The project may potentially make use of the climate scenarios produced by the Robertson project team (see Leveraging CMIP5 and NASA / GMAO Coupled Modeling Capacity for SERVIR East Africa Climate

Projections above) to aid in the assessment of climate change effects on the glaciers and glacier lakes of the HKH.

Abbreviations

AGU: American Geophysical Union
AOD: aerosol optical depth
ARL: Application Readiness Level
ARSET: Applied Science Remote Sensing
ASPRS: American Society of Photogrammetry and Remote Sensing
AST: Applied Sciences Team
CBP: Capacity Building program
CEOS: Committee on Earth Observation Satellites
CHIRPS: Climate Hazards Group InfraRed Precipitation with Station data
CIREN: Chilean Information Center for Natural Resources
DAAC: Distributed Active Archive Center
DSSAT: Decision Support System for Agrotechnology Transfer
EOS: Earth Observing System
EOSDIS: Earth Observing System Data and Information System
EPA: U.S. Environmental Protection Agency
ESD: Earth Science Division
Esri: Environmental Systems Research Institute
FFWC: Flood Forecasting and Warning Center
FY: fiscal year
GEO: Group on Earth Observations
GEOSS: Global Earth Observation System of Systems
GHG: greenhouse gas
GOMI: Gulf of Mexico Initiative
HKH: Hindu Kush-Himalaya
IAWG: Interagency Working Group
ICIMOD: International Centre for Integrated Mountain Development
IEEE–GHTC: Institute of Electrical and Electronics Engineers Global Humanitarian Technology Conference
ISERV: ISS SERVIR Environmental Research and Visualization System
ISS: International Space Station
LCLU: Land Cover/Land Use
MODIS: Moderate Resolution Imaging Spectroradiometer
MyCOE: My Community Our Earth
NASA: National Aeronautics and Space Administration
NDVI: Normalized Difference Vegetation Index
NGO: nongovernmental organization
NLCD: National Land Cover Database
NOAA: National Oceanic and Atmospheric Administration
RCMRD: Regional Centre for Mapping of Resources for Development
REDD+: Reducing Emissions from Deforestation and Forest Degradation
ROSES: Research Opportunities in Space and Earth Sciences
SBA: Societal Benefit Area
SEAS: *Sargassum* Early Advisory System
SEDAAG: SouthEastern Division of the Association of American Geographers
SERVIR: Regional Visualization and Monitoring System

SERVIR-E&SA: Regional Visualization and Monitoring System-Eastern and Southern Africa
SMAP: Soil Moisture Active Passive
SMD: Science Mission Directorate
SRTM: Shuttle Radar Topography Mission
SSC: Stennis Space Center
UNFCCC: United Nations Framework Convention on Climate Change
USAID: United States Agency for International Development
USGEO: U.S. Group on Earth Observations
USGS: United States Geological Survey
USWP: U.S. Water Partnership
VIC: Variable Infiltration Capacity
WGCapD: Working Group for Capacity Building and Data Democracy
WRI: World Resources Institute
WRSI: Water Requirement Satisfaction Index

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Capacity Building

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